

# Drone-Integrated System for Water-level Observation with Radar Altimeter



Water-level observation measures and records water height in a particular location over time. This is a crucial aspect of hydrology, the scientific study of water and its distribution, properties, and effects on the Earth's surface.

The most popular method for water level observation is attaching simple devices along the shorelines of bodies of water, such as the water tide level measurement scale or water level indicator.

Challenges of the traditional method:

- Limitation to installing in hard-to-reach places.
- No installation option.
- Visual control only.

Another common method is mounting the radar altimeter to the bridge or the stand-alone must.

Challenges of such a method:

- System purchase expenses.
- Installation expenses.
- Operating expenses.
- A limited amount of installation places.
- Vandalism.





The Radar level sensor installed on the UAV is intended to bridge the gap between stationary measurement stations and provide a [more comprehensive picture](#). This solution also allows measurements to be taken on demand in specific locations.

A drone is [compact and easy](#) to transport and deploy. Drones also have high precision in following planned survey lines and can be used anywhere where there is at least a small area for take-off and landing near the surveyed water surface.

The UAV can be flown in autonomous mode at an [altitude of up to 40 meters](#) along the river and provides water surface elevation profiles with [centimeter accuracy](#). Because water is an excellent reflector of microwaves, the radar return will be dominated by water targets. If there are any water surfaces within the footprint of the sensor, those will dominate the return signal.

## Usage scenarios



Water level monitoring for rivers, channels, and lakes



Early flood warning



Water reservoir monitoring and irrigation control



Observing the level of various fluids in the chemical industry



Monitoring levels in wastewater, industrial application

The integrated drone system for water-level observation includes the following:

- A commercially available drone like DJI M300 RTK, M350 RTK (as well as drones based on the Pixhawk autopilot)
- Geolux LX-80-AB Radar level sensor mounted on a gimbal
- SkyHub on-board computer to control the mission and store geotagged measurements
- Onboard software the SkyHub to manage the flight, log data, and deliver real-time sensor data down to the ground
- UgCS software to control the mission





## The sensor

LX-80-AB (Airborne) payload is based on the Geolux LX-80 radar altimeter platform and is a frequency-modulated continuous wave radar sensor that operates in the W-band at frequencies between 77 and 81 GHz. This part of the electromagnetic spectrum is freely available in most of the world for water-level sensing radars. This means that the radar sensor can be operated without needing a specific license to use the electromagnetic spectrum. The radar transmission power is well below any health/safety limits.

## Payload datasheet

| Payload type                | Radar altimeter                                                                                                                                                   |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Weight of the payload       | 0,6 kg                                                                                                                                                            |
| Radar type                  | W-band 77-81 GHz FMCW Radar                                                                                                                                       |
| Beam angle width            | 5°                                                                                                                                                                |
| Max. detection distance     | 40 m                                                                                                                                                              |
| Blind zone                  | 0.2 m                                                                                                                                                             |
| Measurement resolution      | 0.5 mm                                                                                                                                                            |
| Measurement accuracy        | +/- 2 mm                                                                                                                                                          |
| Sampling frequency          | 10 sps                                                                                                                                                            |
| Input voltage               | 9 – 27 VDC                                                                                                                                                        |
| Power consumption           | 1.5 W                                                                                                                                                             |
| Max. peak current           | < 470 mA                                                                                                                                                          |
| Dimensions                  | Ø 65 mm x H 78 mm                                                                                                                                                 |
| Operating temperature range | - 40°C to + 85°C                                                                                                                                                  |
| Interfaces                  | RS-232                                                                                                                                                            |
| IP rating                   | IP68                                                                                                                                                              |
| Certificates and compliance | EN 61326-1:2013<br>ETSI EN 301 489-1<br>ETSI EN 301 489-3<br>EN 62368-1:2014+A11:2007;<br>EN 60950-22:2017<br>EN 61010-1:2010<br>FCC Part 15 class B ISSED RSS211 |

## On-board computer

The heart of the integrated system is **SkyHub** – a small and powerful onboard computer with special software. The SkyHub allows for flight management, logs data, and delivers real-time sensor data to the ground.

One of the main functions of the SkyHub is to log the radar altimetry measurements in geotagged form. The UAV's GPS receiver is used to geotag data. If the drone is equipped with an RTK/PPK receiver, data points will have coordinates with precision down to centimeters.

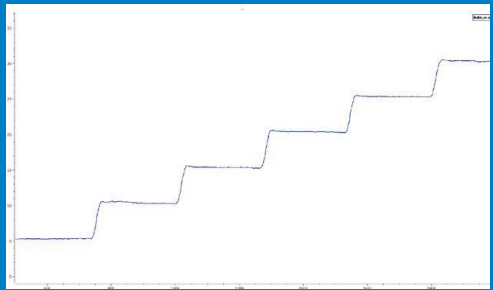
The radar altimeter delivers processed radar distance/altimeter data through an RS-232 serial line ten times per second. This processed data, delivered at a high sampling rate, can be used for positioning and measurement.

Measurements are stored in simple textual CSV format with coordinates, altitude, and additional information, allowing the import to various software capable of processing XYZ data.



The top part of the image shows the drone's path with a Water Level Sensor.

The bottom part shows the sensor measurements in increments of 5 meters for each measurement.



The sensor measurements are in increments of 5 meters for each measurement.

## Ground Control Software

The ground control software is UgCS, with an additional companion application that controls the drone with the sensor. The flight operator on the ground can see the current altitude measured by the radar level sensor.



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